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**PROPOSAL FOR**  
**THE DESIGN, DEVELOPMENT, TESTING AND DELIVERY OF**  
**SPECIAL HEAT GRENADES**

**8 MARCH 61**

**Submitted By:**

**( AMMUNITION POWDER COMPANY )  
RESEARCH AND DEVELOPMENT DIVISION  
SAUGUS, CALIFORNIA**

**Signed:**

**Samuel P. Miller, District Mgr.**

**Name \_\_\_\_\_ Title \_\_\_\_\_ Position \_\_\_\_\_**

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BERMITE POWDER COMPANY

PROPOSAL FOR DESIGN, DEVELOPMENT, TESTING AND DELIVERY OF  
SPECIAL HEAT CARTRIDGE

Bermite Powder Company proposes to provide the necessary engineering, manufacturing and test facilities and labor for the development and testing of a special gasless heat cartridge and adapter tube intended for use in heating liquids contained in standard personnel water canteens equipped with a special type cap incorporating a firing pin and actuator device.

DESIGN AND PERFORMANCE REQUIREMENTS:

**Tube Design and Performance:** The cartridge adapter tube shall conform to the following design and performance characteristics:

1. The adapter tube shall be designed to be insertable by hand into the mouth of the standard personnel water canteen as provided to Bermite by the procuring agency.
2. The outside diameter of the adapter tube shall be the maximum dimension permissible allowing clearance for insertion into and removal through the neck of the canteen. The length of the tube shall not exceed the maximum distance from the edge of the mouth of the canteen to the inside bottom of the canteen.
3. The adapter tube shall be removable by hand from the canteen after the cartridge has been fired and the water heated.
4. The tube shall be configured with the necessary screw threads, clamp, offset contours, adapters, sealing device, and/or other configurations as required to be compatible with the canteen cap and spring-loaded firing device provided to Bermite by the procuring agency.
5. The adapter tube shall be designed to contain and seal in the insertable heat cartridge in a position such that the cartridge ignition element will be in the proper location and alignment with respect to the firing pin in the canteen cap.
6. The adapter tube shall be substantially gas-tight and shall be watertight when properly assembled into the canteen and cap and shall withstand the internal gas pressures generated by the heat cartridge without distortion.
7. The adapter tube shall be constructed of corrosion resistant material suitable to withstand repeated contact with hot water and hot gasses. The material shall be suitable for efficient heat transfer.
8. The adapter tube shall be capable of withstanding twenty random drops from 5 feet altitude onto concrete with and without the cartridge inserted. No damage sufficient to interfere with the intended use and operation of the tube shall be evident after the drops.
9. The tube shall be designed for minimum weight compatible with the strength requirements.

**Cartridge Design and Performance:** The heat cartridge shall incorporate the following design and performance characteristics:

1. The heat cartridge shall be designed to fit snugly into the adapter tube with minimum air gap between the cartridge and the tube. The cartridge shall be insertable into and removable from the adapter tube by hand both before and after firing.
2. The heat cartridge shall contain a conventional percussion-type primer for igniting the heat powder charge. The primer cap shall be located centrally on one end of the heat cartridge case.
3. The heat cartridge shall be a sealed unit designed to be safe and operable after being subjected to the following environmental conditions:

Temperature: Minus 40° F (4 hrs.) and Plus 140° F (4 hrs.)

Shock: 10 foot drop test.

Vibration: Standard frequencies and amplitudes per military specification applicable to transportation in transport aircraft (3 hrs.)

Moisture: Submersion at 3 feet depth for 2 hours.

Altitude: Simulated 40,000 feet for 2.5 hours.

4. Materials to be used in the cartridge shall be selected to facilitate the most economical manufacturing cost compatible with the required functional reliability.

5. The heat cartridge shall contain exothermic "gaseous" heat powder having sufficient stored energy to provide enough heat output when burned to raise the temperature of 2,000 c.c. plus or minus 50 c.c. of distilled water, from 35° F. to 150° F. minimum in 3.5 minutes.

6. The heat cartridge shall be removable by hand from the adapter tube after burning and subsequent cooling have occurred.

#### **TECHNICAL APPROACH:**

Prior extensive, basic research on metal oxidant powders and thermal devices has been conducted by Bermit Powder Company Research and Development Laboratory. Data has been developed which clearly indicates the feasibility of developing a heat cartridge with characteristics defined above. Metal oxidant powders such as Zirconium Barium Chromate, Aluminum Potassium Perchlorate and others have been prepared in useable composition providing 500 to 2400 calories per gram heat output when burned.

In developing the tube and the cartridge, initial effort will be spent on the preparation and testing of various heat powders considered to be adequate for the required performance in the cartridge design. Optimum pressing pressures and consolidating methods will be determined. After selection of the most suitable composition for providing the required performance, the cartridge case and ignition train will be designed and complete experimental rounds fabricated and tested. Design of the cartridge adapter tube will be carried out to be compatible with the cartridge. Stainless steel will be used for the tube unless a more suitable material can be found.

**QUALIFICATION TESTS:**

Fifty cartridges and five adapter tube will be fabricated for the qualification tests. The cartridges will be fired in the adapter tube assembled into the stand-and-water canteen after environmental conditioning as follows:

Ten cartridges will be fired after being cycled through 3 hours vibration and 2 hours submersion and 2.5 hours simulated 40,000 altitude.

Ten cartridges will be fired after being subjected to plus 140° F. for 8 hours and 10 feet drop test.

Ten cartridges will be fired after being cycled from ambient to plus 140° F. (4 hours) to minus 40° F. (4 hours).

Ten cartridges will be fired after being cycled from ambient to minus 40° F. (4 hours) to plus 140° F. (4 hours).

Ten cartridges (as manufactured) will be fired at ambient conditions without environmental conditioning.

**PROGRAM PLAN:**

	Completion (after date of contract)
Powder development and test:	45 days
Ignition train and cartridge case development and test:	55 days
Adapter tube development and test:	55 days
Complete Cartridge Development and test:	70 days
Qualification Tests and Data Reduction:	95 days
Delivery of 15 cartridges and 3 adapter tubes:	105 days
Delivery of drawings, specification, and test data:	110 days

**DELIVERIES:**

The following materials shall be delivered to the procuring agency:

Cartridge Adapter Tube:	3 each
Test Cartridges:	15 each
Manufacturing Drawings and Specification:	1 set reproducibles 1 set prints
Test Data and Reports:	2 copies

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**GOVERNMENT-FURNISHED MATERIAL REQUIRED:**

The procuring agency shall furnish to Bermitite Powder Company within ten days after date of contract two standard water canteens with the special caps containing the firing pin and actuator assembly.

**PERSONNEL:**

The design, development and test program will be conducted entirely at Bermitite laboratory by qualified chemists, engineers and technicians under the general direction of Mr. Louis LePiege, Director of Research and Development.

**TYPE OF CONTRACT:**

In consideration of the developmental nature of the proposed work, we recommend a cost-plus-fixed-fee type contract.

**COST ESTIMATE:**

<b>Labor:</b>	Project Eng.	200 hrs.	@ \$ 5.50	\$ 1,100.00
	Senior Chemist	220 hrs.	@ 4.00	880.00
	Chemist	200 hrs.	@ 3.60	720.00
	Chemist Tech.	140 hrs.	@ 2.90	406.00
	Development Eng.	190 hrs.	@ 3.75	375.00
	Draftsman	80 hrs.	@ 2.60	208.00
	Test Technician	100 hrs.	@ 3.00	300.00
	Blenders	32 hrs.	@ 2.50	80.00
	Leaders	24 hrs.	@ 2.00	48.00
	Machinists	32 hrs.	@ 3.00	96.00
	Inspectors	16 hrs.	@ 3.00	48.00
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	<b>Total Direct Labor:</b>			4,438.50
	<b>Surplus 140% of Direct Labor:</b>			6,213.90
	<b>Payroll Taxes and Ins. 16% of Dir. Labor:</b>			710.16
	<b>G &amp; A 32% of Direct Labor:</b>			1,420.32
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	<b>Sub-total:</b>			12,782.88
	<b>Materials:</b>			
	Powder Chemicals: 25 lbs. @ 20.00		\$ 500.00	
	Purchased Metal Parts:		162.50	
	Primers:		45.00	
	Packaging and Miscellaneous		10.00	
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	<b>Sub-total:</b>			717.50
	<b>Sub-total:</b>			\$ 13,500.38
	<b>Fee:</b>			945.03
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	<b>Total Cost Plus Fixed Fee:</b>			14,345.41

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